Uranium Energy Corp (UEC)

Goliad Project

Production Area Authorization Application for:

Production Area-1 (PA-1)

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3.1 Geology

The permit area is located within the outcrop of the Goliad Sand. The Goliad Sand generally consists of up to 500 feet of light colored sand and sandstone (typically impregnated with caliche) interbedded with clay and gravel. In Goliad County, the subsurface strata generally strike from southwest to northeast and dip to the southeast at approximately 20 feet/mile near the outcrop, and up to 70 feet/mile away from the outcrop (Dale, et al., 1957).

As will be seen in the sections to follow, the descriptive surface and subsurface geology will mirror that given in UEC's Mine Permit Application (MPA), and the same can be said for site-specific hydrology. Because of the expanded database (e.g., the completion of a significant number of monitoring and baseline wells; additional baseline water quality testing; additional exploration/delineation holes; and the completion of hydrologic testing), the subsequent discussions provide a higher level of information and a refinement of the Production Area (PA-1).

As described in Chapter 1.0, the Mine Area (the area encompassed by the Monitor Well Ring) in PA-1 is approximately 94 acres and the Production Area is a little over 36 acres. In preparing a detailed geologic study of PA-1, four dip and strike cross-sections were constructed. The locations where the cross-sections transect PA-1 are shown on Figure 3-1 Cross-section Index Map (see Appendix B). Figure 3-1 also identifies the exploration holes and wells that were used in constructing the cross-sections.

3.1.1 Stratigraphy and Lithology

Within the permit area, the Goliad Formation consists predominantly of fluvial facies, having a relatively high sand content. The up dip parts of the sand axes contain abundant amounts of coarse grained sand and gravel deposited by braided streams and grade down dip into meanderbelt deposits. Farther down dip, the fluvial system grades into deposits of a wave-dominated deltaic system. Generally, the relict river systems to the north of the San Antonio River carried higher sand loads than the relict river systems to the south (Solis, 1981).

The Goliad Formation is approximately 400 feet thick in the permit area, and it is divided into four discrete sand units: Sand A, Sand B, Sand C, and Sand D. Each of the sand units, with the exception of a portion of Sand A across the Northwest Fault, is overlain and underlain by a relatively thick clay/shale layer throughout the permit area. Each of these sand units appears to constitute a discrete individual aquifer unit within the permit area. Figures 3-2 through 3-5 are detailed strike and dip oriented cross-sections through PA-1 which show the stratigraphical, lithological, and structural relationships of the individual sand units. Individually, each of the sand units is confined above and below by a clay/shale layer. Continuity of the confining zones establishes the basis for sand unit definition. The confinement discussed above was thoroughly evaluated by hydrologic pump tests, and the results confirm the effectiveness of the extensive confining layers across PA-1 (see Chapter 4.0, Hydrologic Testing).

Sand A is the upper-most sand in the permit area. In the MPA it was shown that Sand A is overlain by a clay/shale confining layer which has a thickness ranging from about 50 to 70 feet. With the exception of where it outcrops across the Northwest Fault, the clay/shale confining layer is persistent throughout the permit area on the down thrown of the Northwest Fault where production is being planned.

The approximate thickness of Sand A in PA-1 ranges from about 45 to 70 feet (see cross-sections).The upper and lower boundaries of Sand A are discernible on electric logs, and generally quite clear in drill cutting samples. As indicated on the cross-sections the unit is pervasive throughout PA-1. The average depth to the base of Sand A is 99 feet below ground level (BGL) and the average thickness is 65 feet.

Sand B is the next lower sand unit below Sand A. The average depth to the top of Sand B is approximately 152 feet BGL. Sand B, the production zone of PA-1, ranges in thickness from 30 to 50 feet across PA-1 (see Figure 3-6 Net Sand Map in Appendix B). The confining layer between Sand A and Sand B is shown on Figure 3-7 Isopach Map – Thickness of Overlying Confining Layer (see Appendix B). From this figure, it can be seen that the two sands are isolated from each other by a substantially thick clay/shale barrier ranging between 40 and 50 feet in thickness.

Referring again to the cross-sections, it can be seen that Sand C is the third unit, and a proposed production zone, encountered below the surface. The average depth to the top of Sand C is 233 feet BGL and the average depth to the base of Sand C is 269 feet BGL, resulting in an average thickness of 36 feet. Sand C is isolated from overlying Sand B by approximately 20 to 30 feet of clay/shale (see Figure 3-8 in Appendix B).

Sand D is the second underlying sand unit below Sand B. As demonstrated in the MPA, Sand D is isolated from the overlying Sand C and the underlying Lagaro Formation by shale/clay confining layers. A number of the logs in the cross-sections show the Lagarto Clay at the base of Sand D. The average depth to the base of Sand D is 385 feet BGL and its average thickness is 80 feet.

The Lagarto Formation (aka Lagarto Clay) of the Fleming Group (Miocene) underlies the Goliad in the permit area and extends from the base of the Goliad to a depth of approximately 1600 feet BGL. The upper Lagarto looks very similar lithologically to the Goliad. In general, the upper part of the Lagarto is sandier than the middle and lower portions. The sands in the upper portion of the Lagarto are considered part of the Evangeline Aquifer System; however the sands are separated from the overlying Goliad by relatively thick clay layers and probably constitute a discrete aquifer system comprising the first underlying aquifer. In general, the Lagarto is described as clay and sandy clay with intercalated beds of sand and sandstone (Dale, et al., 1957).

The Lagarto is underlain by the Oakville Sandstone (Fleming Group-Miocene). The Oakville unconformably overlies the Catahoula Tuff and crops out to the west and northwest of Goliad County. The Oakville consists of up to 700 feet of crossbedded sand and sandstone interbedded with lesser amounts of sandy, ashy, bentonitic clay.

3.1.2 Structural Geology

As indicated on previously referenced cross-sections and project maps, two strike oriented (southwest to northeast) normal faults are present in the permit area. Based on limited discernable fault intercepts on geophysical logs from exploration holes drilled near the faults, both faults have been determined to be high angle with dips of 65 to 70 degrees. Consequently, the faults are mapped primarily based on stratigraphic offset of correlative beds as indicated on the cross-sections. The fault in the northwest portion of the project area is downthrown on the south side of the fault and demonstrates variable offset but generally indicates approximately 75-80 of the Sand A structural surface.

The fault in the southeast portion of the project area is downthrown to the north side, thus forming a graben structure with the northwest fault through the middle of the mine permit area. Displacement along this fault is approximately 35 feet.

The proposed PA-1 production area is situated entirely within the graben and there are no identified structural features associated with the proposed PA-1 area. Both faults completely traverse the mine permit area and thus their extent in the north-south direction has not been delineated.

3.2 Production Area Hydrology

The following is a brief overview of site hydrology along with an identification of the various sands and confining layers. The purpose of the overview is to provide a general background to site-specific conditions. Because hydrologic pump testing was completed for PA-1, considerably more detail of the site's hydrologic properties is given in Section 4.0 Hydrologic Testing.

It was discussed in the MPA that groundwater movement across the site is generally to the southeast and that the hydraulic gradient is approximately 5.5 feet per mile. It was also estimated in the MPA that groundwater flow is approximately 6.7 feet per year. Additional information from the pump tests show that groundwater flow is approximately 7.9 feet per year.

It was stated in the section on geology herein and in the MPA that on a regional basis the Goliad may be viewed as a single, large aquifer system. It was also noted in the MPA that on a site-specific level (i.e., the permit area) each of the four sands functions as an isolated aquifer; the results of the hydrologic pump test clearly show the isolation of the four sands from each other. Following is a summary description of the aquifers present within the project area.

4.0 **Hydrologic Testing**

The hydrologic testing was performed to comply with TCEQ requirements to obtain a Production Area Authorization (PAA) for in-situ uranium recovery. These requirements stipulate that hydrologic testing must be used to quantify the response of the aquifer that will be mined. PAA-1 is located in Goliad County, near Weesatche, Texas. Hydrologic testing was performed at the PAA-1 site on July 8 through July 15, 2008.

4.1 Test Methodology, Procedures and Goals

The goals, test location, methodology and procedures are discussed in the sections that follow.

The first goal was to confirm that there is hydraulic communication between the monitoring well ring and the wells within the production zone sand (Sand B). This was accomplished by pumping the interior wells completed in the production zone and recording the water levels in the monitoring well ring to show that the production zone monitor wells will in fact be able to detect fluid movement from where uranium recovery is occurring (the production zone). During recovery operations, a net drawdown or "bleed" is maintained in the ore zone by producing (i.e., removing) approximately 1% more water than the amount being injected. This means that there will be a hydraulic barrier to prevent fluid from moving out of the production zone. As an added measure of safety, water quality in the monitor wells must be monitored throughout the recovery and restoration phases of the operation.

The second goal was to analyze the pumping test results. This was done to obtain data on the aquifer's hydraulic characteristics such as transmissivity, storativity, and hydraulic conductivity.

Also, if the data can be analyzed using standard hydrologic techniques, it demonstrates that the drawdown was indeed induced by the testing and not some incidental activity. Both the drawdown phase and the recovery phase of the test were recorded and analyzed.

The third goal was to determine if there is hydraulic communication between the ore sand and the overlying water-bearing zone. The area in Production Area-1 (PA-1) has only one overlying aquifer; Sand A. It is necessary to establish that there is no communication between the fluids in the ore zone and water in overlying aquifers.

4.1.1 Test Area

The PA-1 test area is shown in Figure 4-1. Figure 4-1 also shows the location of the various wells used in the test.

The pumping test wells (PTW) are completed in the Sand B which is the ore zone. This was the primary sand tested. The baseline monitoring wells (BMW) are the production zone baseline wells discussed above and are also completed in sand B. Overlying monitoring wells (OMW) are completed in Sand A which is located above Sand B and isolated from it by a confining clay/shale layer. The objective of monitoring Sand A was to confirm the presence of an effective geologic barrier to flow between the ore zone and any overlying aquifers. Regional baseline wells (RBL) are designated for each sand. Therefore, there are RBLA (Sand A) wells, RBLB (Sand B) wells, etc.

4.1.2 Overview of the PA-1 Pumping Tests

Background water levels and barometric pressure were monitored from 17:00 hours on 7/8/2008 to 11:05 hours on 7/9/2008. Following this, two separate constant rate drawdown and recovery tests were performed at the PAA-1 location. A constant rate test stresses the aquifer through time and gives a good indication of how the aquifer will respond to long term pumping.

4.2 Test Results

4.2.1 Barometric Pressure Measurements

Barometric pressure was measured during the entire PA-1 field test including both the PTW-6 and PTW-1 tests and a background measurement period prior to the PTW-6 test. Figure 4-2 shows the barometric pressure in pounds per square inch (psi) during the test. The barometric pressure was measured using an In-Situ Inc. barometer that was linked to the Hermit recording device.

From the data, the normal diurnal fluctuation in barometric pressure can be seen. Although there was a slight increase in barometric pressure early in PTW-6 test, the atmospheric pressure remained relatively constant thereafter. A weak low pressure system moved into the area just after the start of the PTW-1 pumping phase.

4.2.2 Background Water Level Measurements

PTW-6 Test Background Water Level Measurements

Prior to the start of the first test at PTW-6, background water levels were recorded at 5 minute intervals starting on 7/8/2008 at 17:00 hours and ending at 7/9/2008 at 11:05 hours. Background water levels were recorded in BMW wells 1 through 22, in PTW-5, and overlying Sand A monitoring wells OMW-8 and OMW-9. The change in the water level relative to the initial measurement is shown in Figure 4-3.

From this figure, it can be concluded that there was a small but definite trend of water level decline in all but two of the wells over the 18 hour monitoring period. There was a small rise in water levels in BMW-3 and BMW-19. The maximum change in water levels was approximately 0.05 feet (0.6 inches) with most values in the 0.02 feet (0.24 inch) range. This small amount of change is considered to be negligible and to have an insignificant effect on the interpretation of the test results. The background water level changes are attributed to small changes in barometric pressure as discussed below.

PTW-1 Test Background Water Level Measurements

Background water levels were also obtained prior to the PTW-1 pumping and recovery tests. This information was not used in the analysis that follows because water levels were perturbed due to the prior PTW-6 test and therefore, they may not be representative of true background conditions in the Sand B aquifer.

4.2.6 Hydraulic Communication between Pumped Wells and Observation Wells

The drawdown response to pumping is a measure of the amount of hydraulic communication between wells. Excellent communication between the pumped wells and the observations wells in the baseline monitoring well ring was observed in both tests. This means that the production zone baseline monitoring wells will communicate effectively with the PA-1 production area and therefore serve their intended function as monitor wells to protect water quality.

As discussed in the previous sections, the water level response to pumping was significantly greater than what could be attributed to barometric pressure changes. Also, as discussed below, the drawdown response in the monitoring ring wells was analyzable for aquifer parameters. This provides evidence that the observation well response to pumping is not simply the result of background fluctuations that could be caused by long term or seasonal water level fluctuations due to natural recharge or discharge. Furthermore, the water level changes are clearly induced by the pumpage at PTW-1 and PTW-6.

4.2.7 Hydrologic Communication between Aquifers

The pumping tests in PTW-1 and PTW-6 demonstrate that there is no communication between the overlying Sand A aquifer and B sand aquifers. This is based on the water level response in the OMW series wells. Sand A is in the depth range of approximately

50 to 120 feet below ground level and the OMW wells are completed within this interval. Sand B wells are deeper, with typical completions in the 160 to 200 feet depth range.

In Figure 4-7, there is no discernable response in OMW-8 and OMW-9 to the pumping in PTW-6. The trace of the responses in OMW-8 and OMW-9 are superposed and fluctuate slightly around the 0 water level point. The response in the other wells to the pumpage is quite clear in Figure 4-7. Figure 4-10 shows that there was a very slight increase in water levels in OMW-1 during the PTW-1 test. If there were hydraulic communication between the pumped Sand B and Sand A, there would be an obvious decline in the water level of OMW-1.

Manual water level measurements in the OMW wells given in Tables 4.3 and 4.6 have a similar pattern. There is no detectable response in the overlying Sand A to the Sand B pumpage in either the PTW-1 or the PTW-6 test.

Well Test Analysis Results

The data were analyzable using the standard techniques described above. The expected Theis response was clearly displayed in the data. This means that the tests were properly conducted and that results can be used to characterize the Sand B aquifer.

The results are summarized in Table 4.7. The results between the two tests are similar. The transmissivity appears to be somewhat higher in the region near BMW-12 to BMW-22. The storativity is relatively constant. The analysis show that the transmissivity range is from approximately 377 to 1521 ft^2/day. The storativity ranges from approximately 0.00001 to 0.001. The storativity was anomalously low in PTW-6 from the first test. This may be an artifact of perturbations in the data from the pumping well.

4.3 Hydrologic Boundaries and Recharge Areas

4.3.1 Recharge Boundaries and Recharge Areas

No indications of recharge boundaries were found in the test data. Recharge areas for the A and B sands are located in outcropping areas to the west of the proposed mine. Recharge is by direct precipitation on the outcrop. No indication of any major regional recharge boundaries to the northwest where found in the pumping test data.

4.4 Summary of Conclusions

The first goal of the test was to confirm that there is hydraulic communication between the monitoring well ring and the wells within the production zone sand (Sand B). This was clearly achieved in both tests. This indicates that the production zone monitor wells will be able to detect fluid movement from where uranium recovery is occurring (the production zone). Measures will be taken to prevent such an occurrence. During recovery operations, a net drawdown or “bleed” will be maintained in the ore zone by producing (i.e., removing) approximately 1% more water than the amount being injected. This means that there will be a hydraulic barrier to prevent fluid from moving out of the production zone. As an added measure of safety, water quality in the monitor wells must be monitored throughout the recovery and restoration phases of the operation.

The second goal was to analyze the pumping test results. This was done to characterize the aquifer and obtain data on the aquifer’s hydraulic characteristics such as transmissivity, storativity, and hydraulic conductivity. The data were of good quality and were analyzed using standard hydrologic techniques. The analysis shows that the transmissivity range is from approximately 377 to 1521 ft^2/day. The storativity ranges from approximately 0.00001 to 0.001. Finally, no communication was observed between Sand B and the overlying Sand A.

4.5 References

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